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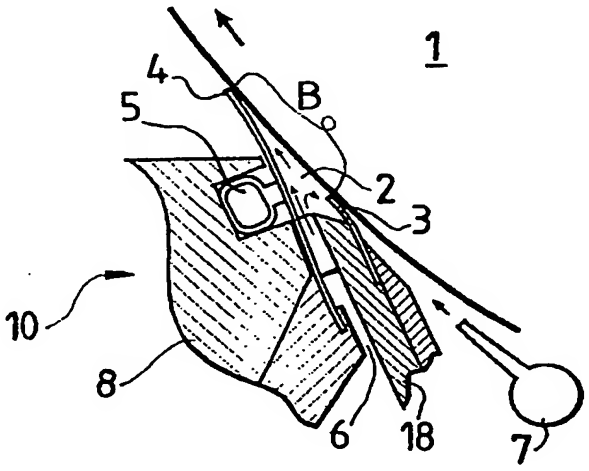

(57) Abstract

The present invention relates to an applicator apparatus (10) for a film–transfer coater. The applicator apparatus (10) includes an applicator chamber (2) bordered by an area (B) on the surface of said rotating applicator roll (1) and by an applicator apparatus (10) comprising a doctor (4, 12) adapted to extend in the direction of the longitudinal axis of the roll essentially over the width of the roll (1). The chamber is further bordered by a dam member (3, 15) located in front of the doctor (4, 12) in regard to direction of rotation of said roll (1) so as to extend in the direction of the longitudinal axis of the roll essentially over the width of the roll (1). The applicator apparatus further includes means (6) for feeding the web treatment material into applicator chamber (2) and means (7) for feeding steam into the gap between the applicator roll (1) and the dam member (3, 15) for lubricating the dam member (3, 15).

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Applicator apparatus and method for film-transfer coating

The present invention relates to an applicator apparatus according to the preamble of claim 1 for use in a film-transfer coater employed in coating paper or board, in particular concerning a lubrication arrangement of the doctoring member adapted to the front edge of the pressurized applicator chamber of said applicator apparatus.

The invention also concerns a method for coating paper or board, said method being capable of reducing the friction occurring between the film of coating material remaining after the applicator roll press nip and the member sealing the front edge of said applicator chamber. The chamber front-edge sealing member can be a doctor blade or rod. The lubricant cleans the blade or rod free from foreign matter and size material residues that are then allowed to drip into a collection trough adapted below said chamber front-edge sealing member.

The invention relates generally to methods and apparatuses used for metering coating material on a moving base web of paper or board in a manner comprising first spreading the coating or size on the applicator roll of a size press. Next, the coat film formed on the applicator roll surface is transferred further to the moving web in a nip between the applicator roll and a backing roll.

Conventional coating equipment such as short-dwell applicator apparatuses employed for coating a moving web of paper are understood to include all the arrangements required for feeding the coating material under a positive pressure into the applicator chamber which at its one end is bordered by a doctoring member such as a doctor blade and at its other end by the applicator

chamber front edge, whereby the application zone is formed between the web being coated and the applicator chamber front edge. By feeding the coating material into the applicator chamber with a sufficiently high volumetric rate and positive pressure, an overflow or reverse flow is created thus forming a flow directed reverse to the travelling direction of the web. Herein, a flow running opposite to the web movement is passed via the gap between the applicator chamber front edge and the applicator roll or the web, whereby a liquid seal is provided capable of preventing the passage of air into the applicator chamber.

These kinds of conventional coaters have not been entirely satisfactory in operation. FI patent no. 61,534 discloses a coater in which the coating is applied to the web being coated under a positive pressure with a controlled volumetric rate. When cited method has been used for coating a web of paper, it has been found problematic to prevent the entry of air into the applicator chamber via the gap under the chamber front edge member. Entry of air into the applicator chamber has caused an uneven cross-machine coat profile on the web.

Though it appears possible to prevent air from entering the applicator chamber by way of loading the chamber front edge member against the web, this approach causes fiber and other foreign matter separating from the web to accumulate in the applicator chamber, wherefrom such foreign matter adheres to the doctoring blade thus giving rise to streaking in the applied coat. When the coating line comprises a size press with a roll or a number of rolls, excessive linear loading of the chamber front edge member against the roll may cause wear marks on the roll surface, because the foreign matter released from the web surface tends to remain in front of the chamber front edge member due to the sealing effect of the excessive

linear loading of the member.

Another prior apparatus for coating a moving web is disclosed in US Pat. No. 4,250,211. In this construction, the sealing of the applicator device front edge against entry of air into the applicator chamber is implemented, in regard to the moving web, by means of allowing the coating material to flow past the gap under the front edge member reverse to the direction of the web travel, whereby the reverse flow entirely seals off the gap. As the width of the gap between the moving web and the chamber front edge member typically is in the range of 3-6 mm, the reverse coating material flow must have a volumetric rate of about 20-30 times larger than the portion of coating adhering to the web surface in order to achieve complete sealing off of the gap. When the coating material is first applied to the surface of a roll, the excess coating material flow seals off the gap. Even if the overflow portion could be smaller than what is needed for sealing off the gap with the coating material, it still is relatively large as compared to the amount adhering to the roll surface as a coating material film. If the gap is made wide, the positive pressure of the applicator chamber cannot be easily increased due to the small flow resistance formed by the wide gap to the passage of the coating material therethrough. Hence, any increase of the positive pressure in the applicator chamber also causes a corresponding increase of overflow or, respectively, reverse-direction flow through the gap. On the other hand, if the gap is decreased to, e.g., 1.5 mm, even the smallest variations in the cross-machine profile of the gap due to, e.g., manufacturing defects, will be seen as respective cross-machine defects, or profile defects, in the applied coat. Furthermore, if the gap is made very small, the positive pressure of the applicator chamber may rise due to the increased flow resistance through the reduced gap so high as to cause

problems in the sealing of the applicator chamber side edges.

To avoid the above-described drawbacks in such arrangements, improvements have been made in the manner disclosed in US Pat. No. 4,250,211. According to this patent, the coating material is adhered to the web surface by means of hydrostatic forces acting over a limited area or zone. Herein, reference is made to arrangements described in US Pat. No. 4,250,211 and US Pat. No. 4,839,201 as well as in German patent publication no. 3,338,095. It must be noted that even such systems that utilize hydrostatic forces for the application of a coating material it has been necessary to use an overflow or reverse-direction flow of the coating material past the gap between the application zone front edge and the moving web.

US Pat. No. 4,839,201 describes an apparatus in which the applicator chamber is sealed off by means of two blades or, alternatively, two rods. The coating material is first applied by the apparatus onto an applicator roll and therefrom further to the web being coated. Herein, no actual reverse-direction flow takes place via the gap between the applicator chamber blade or rod and the opposed applicator roll, but instead, a homogeneous layer of water, size that is used or other liquid lubricant is passed in front of said blade or rod, e.g., via holes made to the dam blade. Hence, a lubricant pond is formed in front of the ingoing-side edge member that prevents the friction otherwise occurring between a dry edge member and the applicator roll from causing damage to the roll or the edge member. Although this apparatus construction requires no actual reverse-direction flow to be provided, the zone in front of said blade or rod must anyhow be cleared free from the used lubricant and the coating material or size scraped away from the surface of

the applicator roll by said edge member. As the lubricant in this system is advantageously utilized the same material as is being applied to the web, because then any amount of the lubricant possibly passing into the applicator chamber will not dilute the material contained therein. While the coating material or size used as the lubricant could be replaced by water, its access into the applicator chamber could dilute the material contained therein and, moreover, it can form a film on the applicator roll that prevents the coating material or size from adhering evenly to the roll surface. Hence, lubrication with water may cause coating defects. The handling of water or other liquid lubricant is clumsy due to splashing and, further, since the used lubricant must be collected away from the point of lubrication and returned to the coating material or size circulation, or when using water as the lubricant, to the waste water treatment system.

In the case that the lubricant is a size used for surface sizing of paper or board or coating mix, the above-described apparatus cannot serve in a coater of the nonreturn type, because the lubricant applied to the blade or rod acting as the front edge member of the applicator apparatus always needs a return circulation for the lubricant. Even if the amount of applied lubricant could be minimized, the implementation of the return circulation causes extra costs and the coating material returned back from the circulation to the applicator is always of a lower quality as compared to the fresh coating material or size.

It is an object of the present invention to provide a nonreturn type of applicator apparatus for a film-transfer coater.

The goal of the invention is achieved by lubricating the

front edge member of the applicator chamber using injection of steam into the gap between said member and the applicator roll.

More specifically, the applicator apparatus according to the invention for use in a film-transfer coater is characterized by what is stated in the characterizing part of claim 1.

Furthermore, the application method according to the invention is characterized by what is stated in the characterizing part of claim 5.

Furthermore, the application method according to the invention is characterized by what is stated in the characterizing part of claim 8.

The invention offers significant benefits in the art of coating techniques inasmuch the lubrication of the front edge member of an applicator apparatus by means of steam injected from a steam injector facilitates the manufacture of a final product with improved smoothness of its surface profile. Furthermore, the occurrence of blade streaking in the coated final product is reduced by virtue of the condensing steam that cleans the front edge member of the applicator chamber free from any foreign matter such as fiber and foreign matter adhering to the applicator roll surface. However, the most important benefit of the invention is that the coating mix circulation can be designed as a nonreturn system, which means that all the coating mix fed into the applicator chamber will be transferred onto the applicator roll. Hence, the applicator apparatus can be run without any coating mix return circulation and the applicator chamber is continually filled with fresh coating mix. The quality of the coating mix stays good because no air or foreign matter can become entrained with the mix and the

equipment will remain cleaner. The amounts of coating mix to be handled are smaller inasmuch no excess coating mix or size is needed in the application step. Surface sizing of paper or board can be accomplished by a system of absolutely no return circulation, since the surface size needs no doctoring after application. Obviously, the excess coating material removed by means of doctoring or other smoothing technique from the web surface must be treated in a suitable manner.

In the following, the invention will be examined in greater detail by making reference to the appended drawings in which

Figure 1 is a cross-sectional side view of an embodiment of the invention, and

Figure 2 is a cross-sectional side view of another embodiment of the invention.

The present invention relates to a coating method and apparatus disclosed in US Pat. No. 4,839,201 to which reference is also made herein. This type of apparatus is suited for applying surface size or different kinds of coating materials to a moving web and here such agents and compositions to be applied to a web are generally named as treating agents.

Referring to Fig. 1, therein is shown an applicator apparatus 10 according to the invention. The apparatus 10 comprises an applicator chamber 2 covering area B on an applicator roll 1. The area B is bordered by a doctor blade 4 and a dam blade 3. The doctor blade 4 is an acute-angle blade which is loaded by means of a pneumatic tube 5. In addition to the loading of the doctor blade, the position and angle of the blade support beam 8 in regard to the applicator roll 1 can be adjusted in a

conventional manner to control the operation of the apparatus. A detailed description of these adjustment arrangements are omitted herein.

The volume of the applicator chamber 2 is very small, which means that the turbulence caused by the surface of the roll 1 rotating therein is minimal. The coating mix is fed under a positive pressure and with a desired volumetric rate into the applicator chamber 2. In the embodiment according to the invention, the infeed rate of mix can be kept equal to the amount of mix being transferred to the surface of the roll 1, because there is no need for a lubricating reverse-direction flow. To assure homogeneous spreading of the coating mix film on the rotating roll 1 and an even profile of the applied coat on the web, entry of air into the applicator chamber 2 must be prevented. In the prior art this has been accomplished by passing a portion of the coating mix flow in front of the dam blade 3, reverse to the direction of rotation of the roll 1. Thus, the reverse flow acts as a lubricating flow that simultaneously seals off the dam blade 3. In the embodiment according to the present invention, the applicator chamber 2 is directly sealed against the roll 1 by means of the dam blade 3 which is loaded against the surface of the applicator roll with the help of the blade holder assembly 18. In this case, there is no lubricating flow outward from the applicator chamber 2 onto the dam blade 3, and running the dam blade 3 unlubricated under these circumstances would destroy it quickly, simultaneously also damaging the surface of the roll 1 into an unusable condition. Hence, the gap between the dam blade 3 and the roll 1 must be lubricated in some alternative manner. In the embodiment according to the invention, lubrication is accomplished by virtue of injecting steam by means of a steam injector 7 into the gap between the dam blade 3 and the applicator roll 1. Herein, a steam injector of a tubular shape is used

having an elongated nozzle slot provided to its side.

On the surface of the applicator roll 1, there remains a thin film of coating mix or size even after the roll surface has passed the press nip formed between the applicator roll 1 and its backing roll. So, while the major portion of the coating mix is transferred in the press nip to the web being treated, a thin film of mix always adheres to the surface of the web. The steam injected to the gap between the applicator roll 1 and the dam blade 3 can effectively lower the friction occurring between said dam blade 3 and the thin film on the roll 1. The reduction of friction is partly due to the softening of the film under moisture and heat and partly due to the condensing water. The condensing water can under favourable conditions form under the dam blade 3 a thin condensate film that separates the dam blade 3 from the roll 1. As the moisture content of the injected steam is small, also the amount of condensate water is minimal thus having no detrimental effect on the film being applied to the surface of the applicator roll 1 in the applicator apparatus 10, thus making lubrication with steam capable of overcoming the problems hampering lubrication with water. The water condensing from the steam and the injected hot steam itself clean the dam blade 3 free from adhering foreign matter and accumulating size or coating mix residues. The condensate water and removed foreign matter can be collected into a collection trough adapted to the stem of the dam blade. Condensation of steam can be promoted by cooled structures, e.g., providing the blade holder with a cooling water circulation.

In the above example, the coating mix leveling member is a doctor blade and the applicator chamber front edge is formed by a similar member called a dam blade. It must be noted that depending on the actual design the chamber

front edge can be angled in a desired manner, whereby the dam blade angle with the roll may be varied, e.g., in the range 0-180°.

In Fig. 2 is shown an assembly in which the doctoring member is a rotating rod 12 mounted on a rod cradle 11. The rod 12 and the cradle 11 are supported to the applicator apparatus frame 13 by means of a pressurized tube 14 adapted to control the linear doctoring force of the rod 12. Depending on the application, the doctor rod 12 may be a smooth or grooved rod. Also the front edge of the applicator chamber 2 is bordered by means of a rod 15 adapted in a rod cradle 16 and supported to the applicator apparatus frame by means of a pressurized tube 17. The diameter of the front edge rod 15 is made slightly smaller than that of the doctor rod 12 and, advantageously, the front edge is provided with a smooth rod, because the lubricating effect of steam is better on a smooth-surfaced rod than when using a grooved doctor rod. Moreover, a grooved rod tends to pass size or coating furnish via the grooves to the zone in front of the rod. The front edge rod called the dam rod 15 is lubricated by steam injected from a nozzle 7 that both cleans the rod and lubricates the gap between the applicator roll 1 and the dam roll 15. The linear loading of the dam rod 15 against the surface of the applicator roll 1 is set to a desired value by means of a pressurized tube 17. The rod 15 must be loaded against the applicator roll 1 so strongly that size, coating mix or other web treatment agent cannot pass from the applicator chamber 2 reverse to the direction of rotation of the applicator roll. As the system operates without any reverse flow sealing the gap between the dam rod 15 and the applicator roll, it is extremely essential that the rod is loaded tightly against the applicator roll 1 in order to prevent entry of air into the applicator chamber. Owing to the otherwise sealed structure of the applicator chamber 2,

the treating agent pumped therein can leave the chamber but by being transferred to the applicator roll via the doctor rod 12, whereby no reverse flow occurs. Hence, the apparatus operates without any return circulation. To improve the condensation of steam, the dam rod 15 can be cooled by lubrication water circulated in the rod cradle or by arranging a cooling water circulation into the interior of the rod or in the rod cradle.

In either of the above-described embodiments, the steam injection can be sealed from the machine hall enviroment with the help of, e.g., sufficiently tight hoods. The need for enclosures depends on the amount of steam used, whereby minor amounts of steam may be released into the machine space.

In addition to those described above, the invention may have alternative embodiments. For instance, the lubricating steam can be fed to the chamber front edge dam member using the above-mentioned slotted nozzle or with the help of a set of separate nozzles mounted on said injection tube, using nozzles having a separate steam feed for each, or any other suitable manner. When desired, a doctor blade and a rod-like dam member, or alternatively, a dam blade and a doctor rod may be combined in the same apparatus. Multiple different manners are known in the art for implementing the blade and rod holders and their loading assemblies.

Claims:

1. Applicator apparatus (10) for a film-transfer coater, said apparatus being used for applying a paper or board treatment material to the surface of a rotating applicator roll (1), said applicator apparatus (10) including

- an applicator chamber (2) bordered by an area (B) on the surface of said applicator roll (1) and by an applicator apparatus (10) comprising a doctor (4, 12) adapted to extend in the direction of the longitudinal axis of said roll essentially over the width of said roll (1) and by a dam member (3, 15) located in front of said doctor (4, 12) in regard to direction of rotation of said roll (1) so as to extend in the direction of the longitudinal axis of said roll essentially over the width of said roll (1), and

- means (6) for feeding said web treatment material into said applicator chamber (2),

c h a r a c t e r i z e d by

- means (16, 17; 18) for loading said dam member (3, 15) against the surface of said applicator roll (1) so that a reverse flow of said web treatment material via the gap between said applicator roll (1) and said dam member (3, 15) is prevented, and

- means (7) for injecting steam into the gap between said applicator roll (1) and said dam member (3, 15) for lubricating said dam member (3, 15).

2. Applicator apparatus (10) according to claim 1, c h a r a c t e r i z e d in that said dam member is a smooth rod (15).

3. Applicator apparatus (10) according to claim 1, c h a r a c t e r i z e d in that said dam member is a dam blade (3).

4. Applicator apparatus (10) according to claim 1, c h a r a c t e r i z e d in that said dam member (15) or its holder (16, 18) is provided with a cooling water circulation for condensing injected steam.

5. Method for spreading a web treatment material to a rotating applicator roll (1) wherefrom the web treatment material is further applied to the web of paper or board being treated, in which method

- feeding the web treatment material into an applicator chamber (2) bordered by an area B on the surface of said applicator roll (1) and by an applicator apparatus (10) comprising a doctor (4, 12) adapted to extend in the direction of the longitudinal axis of said roll essentially over the width of said roll (1) and further by a dam member (3, 15) located in front of said doctoring (4, 12) in regard to direction of rotation of said roll (1) so as to extend in the direction of the longitudinal axis of said roll essentially over the width of said roll (1),

c h a r a c t e r i z e d in that

- loading said dam member (3, 15) against the surface of said applicator roll (1) so that the flow of said web treatment material in a direction reverse to the direction of rotation of said

roll (1) via the gap between said dam member (3, 15) and said applicator roll (1) is prevented, and

- injecting steam into the gap between said dam member (3, 15) and said applicator roll (1) for the purpose of lubricating said dam member (3, 15).

6. Method according to claim 5, c h a r a c t e r - i z e d in that the infeed rate of the web treatment material into the applicator chamber (2) is equal to the amount of web treatment material being transferred to the surface of the roll (1).

7. Method according to claim 5 or 6, c h a r a c - t e r i z e d in that said dam member (15) or its holder is cooled.

8. Method treating a web of paper or board with a web treatment material, said method comprising the steps of

- spreading the web treatment material on an applicator roll (1) in a film-transfer coater,

- passing the web being treated into a nip formed between the rolls of a film-transfer coater, in which nip the web treatment material spread on the applicator roll (1) is adhered to the web,

- feeding the web treatment material onto said applicator roll (1) from an applicator chamber (2) bordered by an area (B) on the surface of said rotating applicator roll (1) and by an applicator apparatus (10) comprising a doctor (4, 12) adapted to extend in the direction of the longitudinal axis of said roll essentially over

the width of said roll (1) and further by a dam member (3, 15) located in front of said doctor (4, 12) in regard to direction of rotation of said roll (1) so as to extend in the direction of the longitudinal axis of said roll essentially over the width of said roll (1),

c h a r a c t e r i z e d in that

- loading said dam member (3, 15) against the surface of said applicator roll (1) so that the flow of said web treatment material in a direction reverse to the direction of rotation of said roll (1) via the gap between said dam member (3, 15) and said applicator roll (1) is prevented, and

- injecting steam into the gap between said dam member (3, 15) and said applicator roll (1) for the purpose of lubricating said dam member (3, 15).

9. Method according to claim 8, c h a r a c t e r - i z e d in that the web treatment material used is a surface size.

10. Method according to claim 8, c h a r a c t e r - i z e d in that the web treatment material used is a coating mix.

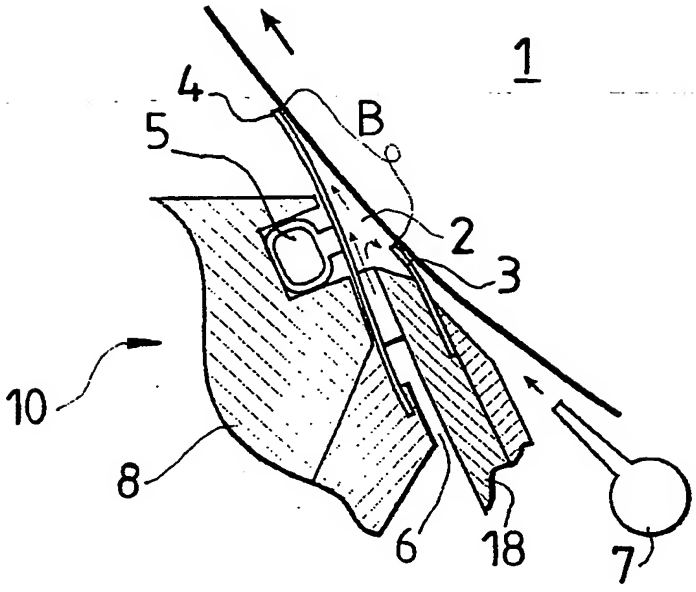

FIG. 1

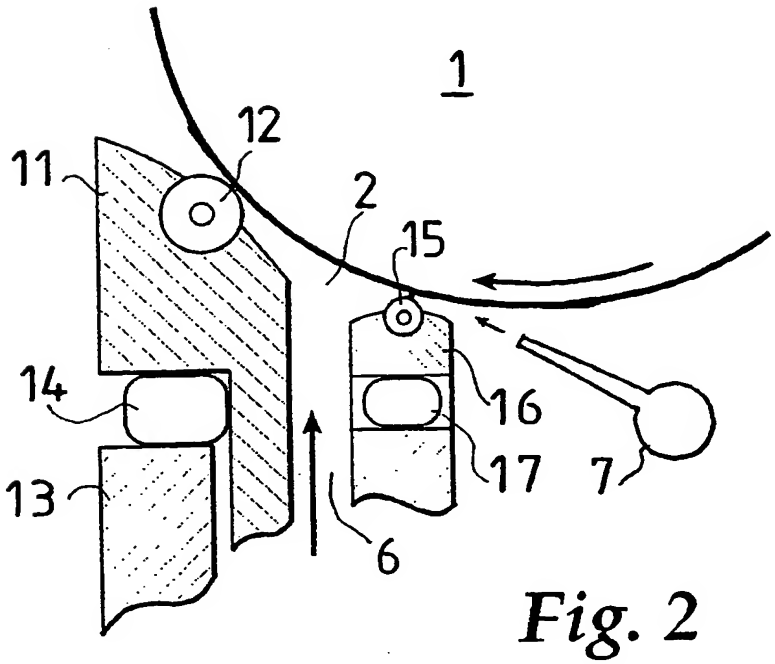

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00436

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21H 23/52, B05C 5/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B05C, D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4839201 A (RAUNO RANTANEN ET AL), 13 June 1989 (13.06.89), claim 1	1-10
Y	US 5567479 A (RAUNO RANTANEN), 22 October 1996 (22.10.96), abstract; column 2, line 20 - column 3, line 30	1-10
A	US 5376177 A (DAVID R. ELVIDGE ET AL), 27 December 1994 (27.12.94)	1-10
A	EP 0761878 A2 (VOITH SULZER PAPIERMASCHINEN GESELLSCHAFT MBH), 12 March 1997 (12.03.97)	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
16 Sept 1999	21 -09- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Barbro Nilsson/EÖ Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/08/99

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4839201 A	13/06/89	AT 88922 T	15/05/93
		CA 1324740 A	30/11/93
		DE 3880797 A	09/06/93
		EP 0319503 A,B	07/06/89
		SE 0319503 T3	
		FI 81734 B,C	31/08/90
		FI 875333 A	04/06/89
		JP 1194966 A	04/08/89
US 5567479 A	22/10/96	CA 2111291 A	16/06/94
		EP 0603145 A	22/06/94
		FI 925704 A	16/06/94
		FI 935667 A	19/07/94
US 5376177 A	27/12/94	AU 7379694 A	28/02/95
		CA 2167724 A	16/02/95
		DE 69404040 D,T	16/10/97
		EP 0713549 A,B	29/05/96
		SE 0713549 T3	
		FI 100813 B	00/00/00
		FI 960579 A	08/02/96
		WO 9504858 A	16/02/95
EP 0761878 A2	12/03/97	CA 2184516 A	02/03/97
		DE 19532388 C	19/12/96
		JP 9103731 A	22/04/97
		US 5788771 A	04/08/98

Form PCT/ISA/210 (patent family annex) (July 1992)